



INDIAN CENTRAL COTTON COMMITTEE.

Cotton Improvement in India

BOMBAY,
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F O R E W O R D .

IN 1925 the Indian Central Cotton Committee made a comprehensive review of the improvements in cotton accomplished up to that date by the Provincial Departments of Agriculture and at the same time it also laid down for the ensuing five years the general policy to be followed in respect of its own contribution towards the betterment of Indian cotton. The progress made since the subject was last reviewed was recorded in a note prepared by the Secretary and placed before the last meeting of the Committee. This note also gave the Secretary's views on the part the Committee should play in future research work and the spread of improved varieties. It was decided that the note should be published in a slightly abridged form for distribution to all bodies concerned with cotton as it contained information of considerable interest. It was also hoped that by publication the Committee would obtain the co-operation of the public and gather opinions on the future policy proposed in the note. Its past work the Committee is prepared to leave with confidence to the judgment of time. Its research work is only eight years old and already in that short time much has been achieved and much more is well on the way to success. The next decade will be very fruitful of results and accomplishment. The Committee has agreed to help Agricultural Departments in bringing the results of its Research Schemes to the notice of the growers, so that in future there should be a much more rapid spread of improvements than has been possible in the past. Any suggestions which will help forward the work of improving Indian cottons will be welcomed and given every consideration by the Committee.

JOSEPH A. KAY,
Vice-President,
Indian Central Cotton Committee.

BOMBAY, 25th August, 1931.

INDIAN CENTRAL COTTON COMMITTEE.

REVIEW OF COMMITTEE'S WORK AND RESEARCH POLICY.

CHAPTER I.

In 1925 the Committee published a small pamphlet in which was outlined the policy of Agricultural Research followed since the passing of the Cotton Cess Act in 1923 provided the Committee with funds and also the policy it intended to follow during the ensuing five years. This period is over and it is now necessary to review what has been achieved and to enunciate a new policy if the experience acquired during the last eight years necessitates a different outlook in the matter of research into cotton problems.

The broad general lines of policy laid down in 1925 were :—

- (1) That Technological Research should be under the Committee's own direction and control.
- (2) That Agricultural Research should be promoted by :—
 - (a) grants-in-aid to Provincial Agricultural Departments and other institutions, and
 - (b) the creation of research studentships.
- (3) That a Central Agricultural Research Institute for cotton work was necessary.
- (4) That grants-in-aid should be in support of schemes of more than local importance.
- (5) That the Committee should by every means in its power provide for more qualified research workers on the problems connected with cotton improvement.
- (6) That the work of the Agricultural Departments should be supplemented and the Committee should not compete with them or permit the use of cotton cess funds to enable Local Governments to reduce their own expenditure on cotton improvement.

The Committee adopted the principle of subsidizing existing institutions for special investigations on the grounds that this procedure would enable advantage to be taken of existing buildings, land, equipment and experienced staff, and was thus likely to lead to the maximum return from a limited expenditure.

CHAPTER II.

WORK DONE AND IN PROGRESS FOR THE IMPROVEMENT OF COTTON IN INDIA.

(A) *By Botanical Means.*

BOMBAY.

Surat.—From the whole of the tract south of the Narbada, comprising some 550,000 acres, the old inferior *Goghari* has been mostly replaced by improved types supplied by the Agricultural Department. 1027 A.L.F. (staple 1 inch full) is now grown on about 450,000 acres; 1-A *Long Boll* (staple 7/8 inch) and other inferior types cover the rest of the area.

Further work is in progress. *Broach 3* appears to be promising.

Broach.—Work is in progress by the Agricultural Department. Two wilt-resistant types are under trial.

Dholleras.—Work is in progress by the Agricultural Department. *Wagad 8* and *Cutch No. C. 331* appear to be promising. The former is grown on about 50 acres.

The Committee is financing a scheme for the extension of the area grown under 1027 A.L.F.

Khandesh.—*Banilla*—a cross between *Bani* and *Comilla*—made by the Agricultural Department many years ago is the result so far achieved. Unfortunately it has deteriorated in spinning value from 20's to 13's but is still a distinct improvement over the local cotton or the *N.R.* variety introduced some years ago by the Agricultural Department. It was grown this year on 30,000 acres.

Further work is in progress. Amongst others *B XXI*, spinning 30's, is under observation.

The Committee is financing a scheme for the extension of *Banilla* cotton.

Kumpta.—Several improved types are under cultivation. *Dharwar 1* (staple 1 inch) covers about 60,000 acres. *Dharwar 1 x Rosea* (staple 6/8 inch to 7/8 inch) is grown on a small area of 3,800 acres but will be replaced by *Jayawant*. *Jayawant*, a recent selection with a staple of 1 inch, is now being widely distributed. It will replace *Dharwar 1* and cover an area of 200,000 acres in the coming season. Further work is in progress.

The Committee is financing a scheme for obtaining wilt-resistant strains for the *Kumpta* area and another for the extension of *Jayawant* cotton.

Dharwar-Upland.—An improved type—*Gadag 1* (staple over 7/8 inch)—is now cultivated on an area of 124,000 acres. This also is the work of the Agricultural Department.

The Committee has given a grant for the extension of this variety in the *Gadag* tract.

SIND.

Bengal-Sind.—27 W.N., an improved type of *desi* having a staple of $\frac{1}{2}$ inch, is now under cultivation.

Sind-American.—The Punjab-American 4-F type (staple about 1 inch) is now grown over 65,000 acres. Trials with Egyptian and American types are in progress.

The Committee gives a grant for physiological investigations in Sind and has also sanctioned funds for the rapid extension of the improved varieties decided on by the Agricultural Department.

MADRAS.

Tinnevelly.—Formerly this was a mixture of *G. herbaceum* (6/8 inch to 7/8 inch) and *G. indicum* (*Karunganni*)—staple 7/8 inch. Now a large proportion of the Tinnevelly crop consists of *Karunganni*. Two selections of *Karunganni*—*C. 7* and *A. 10*—are now under cultivation and cover an area of 15,000 acres. The staple of both is about 1 inch. Further work is in progress by the Agricultural Department.

Cambodia.—Unirrigated *Cambodia* has an average staple of 6/8 inch. Irrigated *Cambodia* is much superior, having a staple of about 1 inch. Two selections—*Co. 1* and *Co. 2*—have recently been given out, but *Co. 2* is the one now being pushed. The area covered by these improved types is about 35,000 acres. A seed extension scheme is being financed by the Committee.

Northerns.—Ordinary *Northerns* has a staple of 7/8 inch. Selection No. 14 (staple 1 inch) now covers about 27,000 acres.

Westerns.—Ordinary *Westerns* has a staple of 13/16 inch. The selection *H. 1* (staple 7/8 inch) is expected in the near future to cover an area of about 200,000 acres.

Salems.—Work in progress to evolve a type of cotton as hardy as *Uppams* (*Salems*) and as good as *Karunganni* in staple is being financed by the Committee. There are 800,000 acres of rain-fed cotton in need of such a type.

Cocanadas.—Work is in progress by the Agricultural Department.

CENTRAL PROVINCES.

Central Provinces and Berar Oomras.—At first work was directed towards providing the *ryot* with a high-yielding type, and *Roscum* was the result. Recently a new selection (*Verum 262*) having a staple of over 7/8 inch has been made. The whole of this tract will, it is hoped, be grown with this variety or further selections from *Verum* within a few years.

The production of *Verum 262* was financed by the Committee and help has also been given with a seed extension scheme for *Verum* cotton.

CENTRAL INDIA.

Central India Oomras.—The work of isolating improved strains for Central India and Rajputana is in progress at the Institute of Plant Industry, Indore. Improved *Malwa* and other types are under trial. This is being financed by the Committee.

RAJPUTANA.

Bengals.—Work is in progress at Bikaner. This is being financed by the Committee.

HYDERABAD.

Gaorani-Comras.—Having protected the once famous *Gaorani* tract from the influx of inferior cottons from outside, the Agricultural Department is now producing and distributing pure *Gaorani* seed in the area. Plant breeding work is also in progress from funds supplied by the Committee.

Buri-Jayar-Comras.—No work has yet been done on the cottons of this area.

UNITED PROVINCES.

Bengals.—Work is in progress at the Cawnpore farm to obtain a suitable long-staple cotton for the irrigated tracts of the Provinces. A high-yielding, high-ginning *neglectum* cotton is also being distributed.

PUNJAB.

Punjab-American.—*4-F* (staple 7/8 inch) and *289-F* (staple 1 inch full) types are now under cultivation and cover an area of $\frac{3}{4}$ million to 1 million acres. These two types, however, suffer from the defect that they are susceptible to the peculiar climatic conditions which cause the periodic "failures" of the American crop in the Punjab. Work is in progress to find a type immune to such conditions, and several promising strains are being tested by the Cotton Research Botanist and his staff.

Bengals.—Three improved types—*G. N. Roseum*, *G. I. Mollisoni* and *G. Sanguineum*—are under cultivation. Further work is also in progress.

The Committee is financing a scheme for the production of improved cottons for the Punjab.

BURMA.

Wagale and Wagyi.—Selection work on these two varieties is in progress by the Agricultural Department.

The Committee is financing a small scheme of cotton improvement in Burma.

MYSORE.

Kumpia.—Selection work has yielded a strain known as *Selection 69* (staple 7/8 inch) which is now cultivated over an area of 15,000 acres.

American.—A Mysore-American selection is now under trial.

BENGAL.

An attempt is being made on the Rangamati Farm to select a high-yielding and high-ginning cotton from the local trade type.

SUMMARY.

It will be seen from the above statement that work is in hand by the several Agricultural Departments in India for the improvement of each of the chief types of Indian cotton. Assistance has been given by the Central Cotton Committee to the following Provinces or tracts for the production of improved types of cotton :—

- (1) Punjab (both American and *desi*),
- (2) Central Provinces and Berar (*Verum 262*),
- (3) Khandesh (*Banilla*),
- (4) Dharwar (*Jayawant*),
- (5) Hyderabad (*Gazorani*),
- (6) Madras (*Sams*), and
- (7) Central India (*Malwa* cottons),

while the following tracts have so far received no help from the Committee for this purpose :—

- (1) Surat, (2) Broach, (3) Dholleras, (4) Sind, (5) Cambodia,
- (6) Northerns, (7) Westerns, (8) Tinnevellys, (9) Cocanadas,
- (10) Barsi-Nagar Oomras, (11) U. P. Bengals, (12) Burmahs,
- and (13) Mysore.

A scheme was submitted to the Committee by the United Provinces Government for work on U. P. Bengals but was rejected as it entailed capital expenditure for buildings.

In addition to the provision of funds to Provinces for the production of improved varieties, the Committee is also assisting in the extension of the seed of improved varieties of cotton in the following areas :—

- (1) Central Provinces and Berar for *Verum 262*,
- (2) Khandesh for *Banilla*,
- (3) Dharwar for *Jayawant*,
- (4) Gadag for *Godag No. 1*,
- (5) Hyderabad for *Godag 1* and *Dharwar 1*,
- (6) Madras for *Cambodia*,
- (7) Surat for *1027 A.L.F.*,
- (8) Sind for the improved cottons decided on.

The Agricultural Departments are in possession of improved varieties of cotton for each of the big cotton areas of India and the Committee is taking a substantial share in the work of evolving and spreading improved varieties, though much more could be done in both these directions. In Chapter IV of this note will be found suggestions for the development of this work.

(B) *Physiological, Entomological and Mycological Work on Cotton.*

In addition to the improvement of cotton by purely botanical means and by the extension of improved varieties, the Committee is financing several schemes which deal with the study of environmental factors as they affect the crop. The causes of bud, flower and boll shedding are being investigated at Surat, and though the investigation has not yet led to any important practical results for this tract, it has supplied a considerable amount of valuable

knowledge regarding the cotton plant which may be of use in other parts of India. The physiological investigation financed by the Committee in Sind aims at finding out the best sowing dates for the different cottons which will be grown under the Sukkar Barrage, the optimum water requirements of the cotton plant and a study of the alkali problem under the conditions likely to be experienced when the change-over from inundation to perennial irrigation takes place. The investigation into the *Pink Boll-worm* in the United Provinces and the Punjab has supplied a valuable information which can be translated into effective action for the benefit of the grower. The research into the *Earias Boll-worm* at Surat has led to the initiation of a scheme of propaganda over a wide area, which, if carried into practice, will add materially to the bulk and quality of the grower's crop. A scheme of investigation into *White Fly* in the Punjab and work by a Research Student on *Jassids*, as well as the long-delayed scheme of work on *Pempheris affinis* in the Madras Presidency have recently been launched. These embrace the most serious pests of cotton in India. The Committee has undertaken work on each of them. Proposals for further work will be found at a later stage of this review.

Wilt is the principal disease of cotton in India, and the investigations financed by the Committee at Dharwar and Nagpur since 1923 were meant to find out something about the disease and how to combat it. The scheme at Nagpur was closed down in 1928, and unfortunately very little has been discovered regarding remedial measures at Dharwar and the work has been concentrated on the production of wilt-resistant varieties. This is a line of work which could with great profit be pursued in other tracts where wilt abounds.

Root rot is another disease which causes considerable loss, mostly in those parts of the country where it is not found. Wilt seems to be confined to the black cotton soils of India and root rot to the alluvial plains of Gujarat, the Punjab, Sind and the United Provinces.

Summarizing the work into Pests and Diseases of cotton in India that is receiving assistance from the Committee we find that the life-history and means of combating the *Pink Boll-worm* and the *Spotted Boll-worm* have been worked out in the United Provinces, the Punjab and at Surat. In the last mentioned place, intensive propaganda is being carried out this year as a preliminary to a campaign of clean-up measures.

The damage done by *White Fly* and means to check this pest are being studied in the Punjab by means of a grant from the Committee. The investigation has just started.

A Research Student has been given the Punjab *Jassids* to study. Preliminary work has just commenced in Madras on the Stem Weevil (*Pempheris affinis*) by means of a grant from the Committee. The life-history has already been worked out by Ballard and the results published. The scheme is intended to work out control measures.

Wilt disease has been studied both at Nagpur and Dharwar and the chief line of work has been in the direction of securing wilt-resistant varieties. More could be done to obtain wilt-resistant varieties for those parts of India where wilt is prevalent and where so far no work of this nature has been attempted.

Root rot is much more prevalent in certain parts of India than is generally realized and it is necessary that the disease should be studied and means of combating it devised.

(C) *Other Studies on Cotton.*

(1) *Cotton Genetics.*—In each botanical scheme some work has been done on genetics, and the Institute of Plant Industry, Indore, is devoting considerable attention to this branch of study. The Committee's Technological Research Laboratory has also been of great assistance by telling cotton breeders which measurable characters of the lint are of importance in deciding the spinning value of a cotton.

(2) *Unit Species.*—Considerable progress has been made in this work during the last five years at Nagpur, Coimbatore, Indore, Lyallpur and at the several farms in the Bombay Presidency where plant breeding work is being carried on. This information will be collected and published for the use of cotton workers in India.

(3) *The Systematic Botany of Cotton.*—This work might be taken up at a central place, e.g., Indore, when the Unit Species of all the agricultural varieties have been worked out.

(4) *Root Characters* have been and are being studied at Dharwar, Surat, Khandesh, Indore, Akola and Lyallpur. This work is still in its infancy but important results are expected from this study.

(5) *The water requirements of the cotton plant.*—This very important subject is being studied in the Committee's schemes at Lyallpur, Akola, Surat, Indore and Sind, and already important results have been obtained at some of these places.

(6) *Effect of climatic conditions on lint quality.*—The Technological Laboratory is acquiring information on this point and when data for several seasons are available it may be able to assist in predicting the kind of lint from a knowledge of the season.

(7) *Maturing of the fibre in the boll.*—The study of this problem has been taken up quite recently at the Technological Laboratory.

(8) *Causes of resistance to pests and diseases shown by certain varieties.*—Very little has been done in this direction, though a start is being made in the Madras *Pemphères* and *Physiological Scheme* to investigate the reason why certain varieties and strains within varieties are less susceptible to damage by the Stem Weevil.

The success of wilt-resistant cottons in the Central Provinces and Berar and also in Dharwar leads one to think that breeding for wilt-resistance is the most satisfactory method of dealing with the disease at present or until the causes underlying resistance are discovered.

ex-research students of the Committee who have been provided for by Agricultural Departments or employed by the Committee direct. The Committee's Scholarship Scheme was reviewed in 1929 when it was decided that owing to the fact that openings for employment of scholars on the research schemes financed by the Committee were not now so numerous as in the early days, some method should be devised of estimating future developments and the chances of suitable employment being available for a scholar at the expiry of his scholarship before the number and type of scholarships to be awarded in any one year were decided. This necessarily restricts the number of scholars who will be trained but so long as the Agricultural Departments continue to provide suitable men for the Committee's schemes the work of improvement will not suffer. It is really immaterial whether the workers on cotton problems have been lent by Government or are employed direct by the Committee so long as the work is done. If the provision of research scholars adds to the number of workers employed on cotton research, every effort should be made to supply them. If, on the other hand, a scholar merely replaces a Government officer in a scheme and the latter's services are lost to cotton work, which is very probable, these scholarships as a means of building up a cadre of trained workers in cotton appear to me to be of doubtful value.

Again, the Committee is anxious to get the best brains in pure Science from the Indian Universities but Departments of Agriculture will absorb only men with agricultural qualifications and usually men belonging to their own Province. Unless the Committee therefore definitely creates posts for them, such men are likely to be unemployed at the expiry of their scholarship period. Every effort is made by the Committee to find employment for its research students and out of the 46 trained and under training only 3 are without work. As pointed out above, it is becoming more and more difficult to find posts in the Committee's schemes and I consider it would be wrong of the Committee to award scholarships unless there was a reasonable chance of the men finding suitable posts for which their special knowledge fitted them at the end of their two years' training.

It appears to me, therefore, that the Committee must reconsider its scholarship policy in the light of the above remarks which are based on the experience of Directors of Agriculture. It may be necessary to adopt the plan of giving scholarships only to men already in the Agricultural Department or to those who will definitely be taken on by the Department at the end of their scholarship period. The new schemes proposed in the next chapter open up possibilities of employment for a large number of extra workers most of whom will doubtless be forthcoming from the Agricultural Departments though there is every prospect of those students at present unemployed finding suitable posts.

CHAPTER IV.

PROPOSALS FOR FUTURE WORK.

The further expansion of the Committee's programme of work must be regulated by the funds at its disposal and by the future of the schemes now in operation while the rate of expansion will to a large extent depend on the policy which the Committee adopts with regard to the schemes now being financed. Botanical schemes will require at least a decade before reliable results are available and even then the strain obtained must not be considered

In the Madras Presidency, *Cambodias*, *Tinnevellys*, *Northerns*, *Westerns* and *Cocanadas* have each been improved and the improved strains now cover many thousands of acres. A small Seed Extension Scheme is in operation for *Cambodias* in the Coimbatore District but no help of any sort has been asked for from the Committee for the improvement or extension of any of the other varieties. Seed Extension Schemes for the rapid dissemination of the improved varieties already in hand, which would add materially to the growers' profits and supply mills with larger quantities of improved cottons, are greatly to be desired.

No work has been done hitherto to improve the *Barsi-Nagar Oomras* cottons which in the latest forecast amount to 262,000 bales. A botanical scheme could with advantage be started here as well as an investigation into the very low yield obtained from this tract.

A scheme was put forward by the United Provinces Government for work on the *desi* cottons of that Province, but was not accepted by the Committee as it entailed capital expenditure on buildings. The U. P. Bengalas are a very important constituent of the Indian crop and something should be done to improve the cotton of this tract. An increase of even Re. 1 per acre to the profits of the United Provinces cotton grower means in the aggregate an annual sum of Rs. 8½ lakhs which is being lost by delay.

The success of the improved varieties of Burmese cotton is dependent on an improvement in cultural methods, and at the last meeting the Committee sanctioned a scheme working towards this end.

The investigation into the damage done by the *Pink Boll-worm* in the United Provinces and the devising of methods to combat the pest have been completely successful. Experiments have shown that the elimination of this pest would add Rs. 30 an acre to the grower's profits or an aggregate of Rs. 2½ crores per annum. The Committee cannot allow this valuable piece of work to die of inattention. The experimental heat treatment of all seed in the Aligarh District was so encouragingly successful last year that something should be done to extend the practice over the whole of the cotton-growing districts of the United Provinces and the badly infested portions of the Punjab. The principle of helping to bring into practice the successful results of Research Schemes has been accepted by the Committee and the first instance of this was its decision to help the Bombay Agricultural Department with funds to eliminate the *Spotted Boll-worm* in Surat by clean-up measures. It is to be hoped that no difficulties will be put in the way of aiding the United Provinces Agricultural Department in their efforts to get rid of the *Pink Boll-worm* from the crop. The experiment in the United Provinces will be of great value to the South-East Punjab and the surrounding Indian States in Rajputana and Central India and also to the north of the Central Provinces.

Where these two *Boll-worm* pests are prevalent, an effort should be made to find out how they are carried over from year to year as a preliminary to further action depending on the results of the operations in Surat and in the United Provinces.

It is too early yet to anticipate the results of the investigations into *White Fly*, *Jassids* and *Scent Weevil*, and until these results are forthcoming it is impossible to forecast what help the Committee can give.

In all *wilt*-infected areas not already tackled, it is suggested that the Committee should start schemes of breeding for *wilt*-resistance, e.g., in Khandesh and Broach. The fundamental research into *wilt* should, I consider, be concentrated at the Indore Institute which should be provided with all the necessary facilities for carrying out the work. All other *wilt* work, except that part devoted to the production of *wilt*-resistant strains, should be closed down.

An investigation into *Root Rot* is necessary, as it is much more widely spread than is generally realized. The Committee should, I consider, finance a scheme for this purpose because the disease appears to be found over all the cotton-growing areas of India.

Another piece of work which deserves attention by the Committee is an investigation into the cause of excess leafiness in certain types of Indian cotton, e.g. *Kurupas* and *Goranis*. This could be done as an adjunct of the existing schemes. The extreme leafiness of these cottons detracts considerably from their value and prevents them being freely exported.

The Committee has under consideration a scheme for investigating the cost of growing cotton under conditions of peasant proprietorship in each of the main cotton-growing Provinces and States in India. When completed this should be a valuable and authoritative piece of work because of the many conflicting views at present held on the subject.

CHAPTER V.

LONG-STAPLE COTTONS.*

The increasing tendency of Indian mills to spin finer counts is exemplified in the amount of foreign cotton being imported into India. Since the 1st September 1930 to the 14th May 1931, 126,398 bales† of Egyptian cotton, 97,301 bales† of Uganda cotton and 79,017 bales† of American cotton have landed in India, and except in the case of Uganda cotton, some of which has been re-exported, all have been for use in the mills in this country. The past season was a poor one for Indian staple cotton and the import of foreign cotton was to a large extent meant to replace this deficiency, though the low prices were conducive to increased purchase. The production of finer counts in India is undoubtedly on the increase and will continue and India should make some effort to supply the demand from her own fields for all but the very finest cottons. In 1919, the Indian Cotton Committee (McKenna Committee) drew up a statement of the Indian cottons which might be considered to come under the definition of long staple and the commercial quantities of each which might be considered available. This statement is reproduced below:—

* This chapter is included in the note because the substance is directly connected with the improvement of Indian cotton and the policy of the Committee in this connection. It has been added to elicit the views of members because there are two distinct schools of thought, one advocating the growth of long staple cotton as widely as possible in India, the other deprecating the replacement by staple cotton of the short varieties for which there is a distinct demand.

† Converted into bales of $3\frac{1}{2}$ ewts.

Trade name of cotton.	Area in acres.	Estimated quantity falling in specified class, in bales of 400 lbs.
<i>Class I (7/8 inch and over)—</i>		
Tinnovellys (Karunganni)	2,20,000	50,000
Bourbon	10,000	2,000
Cambodia (irrigated)	1,88,000	1,00,000
Punjab-American	2,76,000	1,00,000
Cawnpore-American	2,000	500
Buri	2,000	500
Broach Navsari	Separate figures	not available.
Broach Surat		8,40,000
* Bani		1,68,000
* Northerns		65,000
* Kumpeta		12,00,000
	Total ..	31,77,000
		7,26,000
<i>Class II ($\frac{3}{4}$ inch to $\frac{1}{2}$ inch)—</i>		
Cambodia (unirrigated)	2,83,000	1,00,000
Tinnovellys	3,20,000	84,000
Westerns	11,50,000	1,50,000
Saw-ginned Dharwar	2,50,000	55,000
Wagad	Separate figures	not available.
Salems { Uppam		1,54,000
Nudam ..		10,000
† Malwa ..		1,12,000
† Coccoandas ..		2,61,000
† Wagyi ..		Separate figures
	Total ..	25,40,000
		4,78,000
Total, Class I and Class II ..	37,17,000	12,04,000

In order to compare the present-day production of staple cotton with the figures given above another table is appended showing the average production of the staple varieties for the last five years. This table excludes *Salems*, *Malwa* and *Coccoandas*, which are not 7/8 inch, and *Bourbon*, *Buri* and *Cawnpore-American*, the production of which is negligible and not now available. Deducting these from the table above, it will be seen that in 1920 the production of staple cotton in India amounted to roughly one million bales and the average production of the same class of cotton is now about 1½ million bales. This increase has been due chiefly to the expansion of the area of Punjab and Sind-American cottons and more recently to the introduction of the new *Verum* cotton in the Central Provinces. The improved varieties introduced by the several Agricultural Departments, viz., 1027, *Gadag* 1, *Dharwar* 1, *Jayawant*, *Hagari* 25, *Hagari* 1, *Nandyal* 14, *Karunganni* C-7, Co. 1 and Co. 2, etc., have only replaced existing types which already came under the classification of long-staple cottons, so that though the production of better long-stapled cottons has increased considerably during the last 10 years, there has not been any great increase in the number of bales of long-stapled cotton. It will be noticed that though there has been an increase of nearly 1½ million bales of short-staple cotton in the decade, the increase of long-stapled cotton only amounted to 310,000 bales.

* If marketed pure, these would fall under Class I; as at present marketed they fall under Class II.

† This only comes under this class, if marketed pure.

‡ These cottons only fall in this class, if a regular staple can be evolved.

Indian Cotton Crops classified by staple lengths.

(In thousands of bales of 400 lbs. each.)

	1915-18 average.	Forecast crop.	Trade estimates, normal season.
		Average 1925-30.	
LONG STAPLE—5 INCH AND ABOVE.			
<i>Oomias—</i>			
Hyderabad Geonam .. .	168	186	250
Venur 262 .. .	....	2	200
<i>Broach—</i>			
Surat-Nevsari mostly 1027 A.L.F. (Staple 1") .. .	....	98	
Others .. .	190	77	350
<i>Kurnta-Dharwar—</i>			
Gadag 1 (Staple 1") .. .	....	18	
Dharwar 1 (Staple 5") .. .	....	23	
Javant (Staple 1") .. .	....	....	200
Others .. .	282	245	
<i>Western and Northern—</i>			
Hanari 25 (Staple 5") .. .	....	22	
Hegaw 1 (Staple 5") .. .	....	3	
Nandyal 14 (Staple 15/16" to 1") .. .	....	235	250
Others .. .	103		
<i>Tinnicvellys—</i>			
Karunganni C-7 (Staple 1") .. .	....	3	
Karunganni others (Staple 5") .. .	40	165	
Others .. .	66		180
<i>Cambodia—</i>			
Combatore-1 (Staple 1" and over) .. .	....	7	
Combatore-2 (Staple 1" and over) .. .	....	
Irrigated Cambodia (Staple 1" and over) .. .	101	96	180
Others .. .	65	34	
<i>Punjab and Sind-Americanas—</i>			
289-F (Staple 1" to 1/16") .. .	....	2	
* 4-F (Staple 5") .. .	13	252	450
Total, Long Staple .. .	1,148	1,458	2,060
SHORT STAPLE—BELLOW 5 INCH.			
<i>Oomias (part)</i> .. .	1,631	2,364	2,300
<i>Broach (part)</i> .. .	93	83	....
<i>Dholleras</i> .. .	472	593	400
<i>Bengals</i> .. .	687	936	1,300
<i>Salem</i> .. .	13	37	
<i>Cocanadas</i> .. .	37	43	200
<i>Comillas, Burmahs, etc.</i> .. .	79	108	
Total, Short Staple .. .	3,012	4,164	4,200
GRAND TOTAL .. .	4,160	5,622	6,260

* If marketed pure.

The above table cannot, of course, bring out two very important facts which augur well for the future, viz., that within a few years the bulk of the *Oomras* crop will, it is hoped, be replaced by a 7/8 inch cotton and as a result of the Committee's Seed Extension Schemes, the rate of spread of all improved varieties will be much more rapid than has been the case in the past. In order to obtain a better idea of what remains to be done in the way of extending the area of improved varieties, the table below shows the total area under cotton with the area at present grown with improved types. This table shows the leeway that has to be made up in the improvement of the different descriptions of cotton grown in India. Particular attention is invited to the areas still capable of being grown under improved types of those varieties which are classified as long staple. India can grow larger quantities of staple cotton and the general trend of cotton improvement everywhere in India is towards increased length of fibre, but the primary consideration of the workers always has been and will continue to be the best interests of the cultivator. Over large tracts of rain-fed India the early-maturing, high-yielding, high-ginning, short-staple, hardy cottons indigenous to the area will compete successfully against any attempt to introduce a long-staple type, but there are other areas, like the Central Provinces and Berar, for which a staple cotton may be found which will give the growers immediate increased profits. What effect will an increase in the supply of staple cotton and a decrease of short-staple cotton have on the prices of these two commodities? Is it desirable that India should enter the field as a large-scale producer of cotton which competes with American and by so doing give up producing over a large area the cotton of which she has a virtual monopoly?

Distribution of cotton area by varieties and civil divisions.

• Average of the five seasons—1925-30—(In thousands of acres).

Provinces and States— Trade descriptions of cotton.	Average area under each trade descrip- tion in each Province and State.	Progress in the introduction of improved varieties.		REMARKS.
		Area.	Names of varieties.	
<i>Bombay including Baroda</i>				
<i>State—</i>				
Surat-Nasvari ..	350	* 450	1027 A. L. F., † Broach 51.	Only 13,000 acres are under the control and supervision of the Agricultural Department.
Broach ..	744	...	Types under trial.	
Dholleras ..	2,922	6.65	Wogad-8; † Cutch C. 331.	
Khandesh ..	1,411	30	Banilla†.	
Kumpta ..	1,347	§ 200	Jaywant; Dhar- war 1.	† Still under trial.
Dharwar-American ..	300	§ 200	Gadung-1.	
Westons ..	133	...	....	Has deteriorated in spinning capacity.
Barsi and Nagar ..	313	..	....
<i>Sind—</i>				
Americans ..	20	..	Several types under trial.	
Bengals ..	323	..	..	\$ Areas expected under the Seed Distribution Schemes already sanctioned.
<i>Punjab—</i>				
Americans ..	966	5	280-F, † Early strain.	
Bengals ..	1,686	....	....
<i>United Provinces—</i>				
Bengals ..	821	1	C. 402.	Grown in the Sarda Canal area.
<i>Central Provinces and Berar—</i>				
Omras C. P. & Berar ..	5,058	150	Venuri 262.	
<i>Central India—</i>				
Omras Central India ..	1,953	....	Selected types under trial at Indore.	
<i>Rajputana States—</i>				
Bengals-Rajputana ..	444	....	....
<i>Ajmer-Merwara—</i>				
Bengals-Rajputana ..	43	....	....
<i>North-West Frontier Province and Delhi—</i>				
Bengals-Sind Punjab..	24	....	....
<i>Madras—</i>				
Tinnevellys ..	602	30	(a) Kanchiunganni C-7 and A-10. (b) Co. 1 : Co. 2.	(a) Seed farm only about 1,000 acres.
Cambodia ..	358	32	(b) Nandyal-11.	
Northerns ..	450	27	(c) Haagaxi-1 ; Hagai-25.	(b) Seed farm area less than 2,000 acres.
Westerns ..	645	160		
Cocanadas ..	200	....	....
Salems ..	200	....	....
<i>Mysore—</i>				
Kumpta-Dharwar ..	73	15	Selection 69.	(c) Seed farm area about 8,000 acres.
Others ..	8	....	....
<i>Burma—</i>				
Wagale and Wagy ..	376	....	....
<i>Assam, Bengal, Bihar and Orissa—</i>				
Comillas and Bengals ..	199	....	....
<i>Hyderabad—</i>				
Hyderabad Gaorani ..	1,200	....	....
Barsi and Nagar ..	2,140	....	....
Westerns ..	290	....	....
Cocanadas ..	23	....	....
Total ..	26,152			

J. H. RITCHIE,
Secretary.

CHAPTER VI.

THE PAST ACTIVITIES AND THE FUTURE PROGRAMME OF WORK OF THE TECHNOLOGICAL LABORATORY OF THE INDIAN CENTRAL COTTON COMMITTEE.

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INTRODUCTION.

THE following note is divided into two parts. Part I is devoted to a review of the activities of the Technological Laboratory of the Indian Central Cotton Committee since its inception in 1923-24 up to the present time. It is not intended that this review should be a historical sketch of the origin and growth of the Laboratory, nor that it should be encumbered with too many details. It is rather meant as a general survey of the work which has been done during the last seven years and of the contribution which the Laboratory has made to the cause of the cotton-growing industry in India. Part II contains some suggestions for extending the scope of the activities of the Laboratory, as well as a programme of Technological Research for the near future. This must not be regarded as exhaustive or final, for, at any time, fresh problems may be suggested by the results of the experiments going on here or abroad, or new activities may be undertaken according to the pressing needs of the trade.

PART I.

The activities of the Laboratory may conveniently be classified under the following heads :—

- (1) Testing of Agricultural samples ;
- (2) Testing of Trade samples ;
- (3) Prediction of the spinning value of a cotton from a knowledge of its fibre-properties ;
- (4) Research on cotton fibre ;
- (5) Technological Research ;
- (6) Moisture content of cotton ;
- (7) Miscellaneous.

(1) *Testing of Agricultural samples.*—A large number of Agricultural Officers are engaged in the task of evolving new types of cotton which they could confidently recommend to the cotton growers, as being, in one respect or another, superior to the existing types. They do this, in the first instance, by isolating new strains which are likely to prove either more hardy or give higher yield or possess better spinning value. These strains are grown on a small scale on the experimental farms of the departments and their behaviour in the field is carefully watched by the officer. He has, however, no certain method of finding out the spinning values of his new strains. Now the spinning value of a cotton is one of the most important factors in determining its market-value. The grower would naturally prefer to grow cottons which would fetch a better price. The Agricultural Officer, therefore, wants to know, at the earliest possible stage, which of his new strains will give a better spinning performance than the others, to enable him to reject the inferior strains and

concentrate his attention on the superior ones. Lack of reliable information on this point may cause him to waste a good deal of his valuable time on strains which may ultimately prove unacceptable to the spinner, or to reject those which would have given better performance had it been possible for him to know their quality.

The Technological Laboratory fulfils this very important need of the cotton breeder by giving him authoritative valuation of his new varieties. As the surest way, at present, of ascertaining the spinning value of a cotton is by making spinning tests on it, the Laboratory is equipped with a small but efficient spinning plant and a complete range of apparatus and instruments for the determination of the fibre-properties and yarn characteristics of a cotton. The normal routine of the Laboratory has been especially adapted for making tests on small samples to enable the cotton breeder to obtain the necessary information regarding the spinning values of his new strains at an early stage of their selection.

Such new strains as give promising results in the first and second year of their selection are subsequently grown, for several seasons, on the experimental farms. Each season a sample of their lint is sent to the Technological Laboratory for a spinning test. This test consists of a determination, on the one hand, of the more important fibre-properties, i.e., fibre-length and fibre-weight per unit length, and on the other, of the strength, quality, evenness of the yarn spun from the cotton as well as of the loss sustained by it in the blow-room and the number of yarn-breakages in the ring frame. The results of these determinations are detailed in a Technological Report, a copy of which is sent to the cotton breeder. This report helps the cotton breeder to decide which of his strains will be more profitable to the grower.

The facilities offered by the Laboratory have been freely and fully utilized by the Agricultural Officers whose confidence in the results of the Laboratory spinning tests has increased with the lapse of time. This will be seen by the fact that out of a total of 1,100 samples, which have been spun in the Laboratory during the last seven years, 721 samples, or 65 per cent. of the total, were those sent by the Agricultural Officers. The following table gives the distribution of samples spun since 1924 according to the seasons and provinces.

Distribution of samples spun from 1924 to 1931.

Province.	1924- 25.	1925- 26.	1926- 27.	1927- 28.	1928- 29.	1929- 30.	1930- 31.*	Totals 1924- 31.
Bombay	18	26	22	22	28	66	87	269
Punjab	14	1	..	..	42	30	10	97
United Provinces	7	..	6	11	9	7	16	56
Madras	2	19	50	23	30	51	34	209
Central Provinces	2	3	2	2	2	5	3	17
Miscellaneous	3	11	..	6	6	27	20	73
Totals ..	46	57	81	61	117	186	170	721
Standard cotton tests	8	54	49	64	33	31	27	269
Trade tests .. ..	..	..	..	..	..	37	71	108
Total samples ..	64	111	130	128	160	257	268	1,098

* Spun up to 30th June 1931.

It will be seen that the number of samples spun in 1929-30 was nearly five times as many as in 1924-25, and that the number of samples spun in the first ten months of the current season exceeds the total number of samples spun during the whole of the last year. The results of these spinning tests are of invaluable help to the Agricultural Officers in determining their policy with regard to the propagation of their new strains. This is shown not only by the steady increase in the work of the Laboratory, but will also be corroborated by the following remarks made by two Directors of Agriculture, in appreciation of the Laboratory's work, at the 19th General Meeting of the Indian Central Cotton Committee held in July 1929 :—

"MR. MILNE said that he had started work on cotton twenty years ago, and, at that time, he had experienced the greatest difficulty in getting the spinning qualities of the fibres of his new cottons tested. These tests on fibre lay at the basis of a cotton breeder's work and the Laboratory was started primarily to deal with this particular phase of cotton improvement. The Technological Laboratory was an absolute necessity to the work of cotton improvement in India."

"MR. HILSON said that if all the other schemes of the Indian Central Cotton Committee were abandoned and the Technological Institute alone permitted to continue, the Committee would still have fully justified its existence. The Laboratory had taken a great load off his back. In the past whenever he desired to get expert opinion on the spinning value of any new strain of cotton evolved by him in the course of his work, he had to send samples to a commercial mill for testing. He was most grateful for such help from the mills, but, in mill tests, the conditions were naturally bound to vary and the testing of such samples had to fit into the ordinary routine work of the mill. Now he could send his samples to the Technological Laboratory where they were tested under identical conditions and he was thus enabled to make comparisons which told him exactly where he stood in his work. This was an advantage which could not be sufficiently emphasized."

Verum 262, Jayawant and Banilla cottons.—As an illustration of the practical outcome of this collaboration between the Technological Laboratory and the Agricultural Departments the case of *Verum 262* cotton may be mentioned. This cotton has recently been introduced in the market and is a marked improvement upon the low quality *Oomras* which is being rapidly replaced by it. *Verum 262* possesses a comparatively long and fine staple and, grown under the optimum conditions, is suitable for 30's highest standard warp counts. It receives a much better premium and is therefore more profitable to the grower. In selecting it, several strains were tried, for a number of years, and, by a gradual process of elimination, in which the results of the spinning tests made at the Laboratory played a determining part, *Verum 262* was finally selected. Other illustrations of this collaboration are *Jayawant* and *Banilla* cottons. Both are distinct improvements upon their predecessors and the area under their cultivation is being extended.

(2) *Trade Tests.*—Last year the Technological Laboratory took a forward step by offering to undertake tests on representative samples of cotton supplied by the trade. An arrangement was made with the East India Cotton Association whereby the Standard Committee of the Association kindly agreed to supply, for this purpose, samples representing the average cotton crop of the season. These tests are to be repeated, on the same types of cotton, from

season to season. This year similar tests were also made on samples of first arrivals supplied by various mills in Bombay and Ahmedabad through their Associations. There are, consequently, three series of tests which will be repeated on the same types of cottons in successive seasons, viz., tests on standard cottons, tests on samples representing the average crop of the season and tests on first arrivals. When the results of these tests are available for a number of years, the accumulated information regarding the seasonal variation in the spinning qualities of these cottons should be most valuable to the trade.

(3) *Prediction of spinning value of a cotton from its fibre-properties.*—Although, as mentioned above, the spinning test remains, for the present, the most satisfactory method of ascertaining the spinning value of a cotton, it is by no means an ideal method. An alternative method, which has several advantages, consists of correlating the spinning value of a cotton with its fibre-properties. Even though the routine work in the Laboratory has been specially adapted for the purpose of testing small samples of cotton, it takes the cotton breeder about three to four years to produce a quantity of lint sufficient for a satisfactory spinning test. If, at the end of that period, he finds that some of his new strains have not come up to his expectation, all the time and labour spent upon them is practically wasted. Besides, the initial cost of machinery and equipment required for carrying out such tests and the current expense are such that institutions of the type of the Technological Laboratory cannot easily be multiplied. This, therefore, puts a limit to the total number of samples which can be tested by the spinning method. Now the spinning quality of a cotton must ultimately depend, to a very large extent, upon the physical and chemical properties of its fibre. If, therefore, a formula could be developed by means of which it would be possible to predict the spinning value of a cotton from a knowledge of the physical and chemical properties of its fibre, it would not only save the cost of machinery and equipment but would place, in the hands of a cotton breeder himself, the means of ascertaining for himself which of his new strains are likely to be more acceptable to the spinner. He could then perform the experiments on a handful of lint at a very early stage and with inexpensive apparatus. The discovery of such a formula would therefore give a tremendous fillip to the cotton-growing industry. The problem of finding such a formula is by no means an easy one because the fibre-properties of a cotton are variable and highly susceptible to climatic and environmental conditions. It has to be investigated by statistical methods and, for this purpose, it is necessary to have a knowledge of the fibre-properties and spinning values of a large number of samples. Accordingly 20 standard Indian cottons were selected and their fibre-properties, as given below, were accurately determined in each season:—

- (1) Fibre-length ;
- (2) Fibre-weight per inch ;
- (3) Fibre-strength ;
- (4) Fibre-rigidity ;
- (5) Ribbon-width ;
- (6) Convolutions ;
- (7) Clinging power (in some cases).

These cottons were spun in duplicate lots and their yarns were examined for the following:—

- (1) Len strength ;
- (2) Ballistic strength ;

- (3) Single thread strength ;
- (4) Actual count ;
- (5) Actual twist ;
- (6) Evenness ;
- (7) Neppiness ;
- (8) Extension.

Altogether some 100 cottons have been examined in this way during the last six seasons. The results of these tests are now with Dr. Turner who is writing a bulletin on the subject. When this bulletin is published it would be possible to judge what measure of success has been attained in this respect.

(4) *Research on fibre-properties.*—The accurate determination of the fibre-properties of cotton paved the way for the investigation of a number of subsidiary problems. The results of these investigations have been published in the form of Technological Bulletins, Series B. These have often been quoted and reviewed in Textile Journals of England, America, and the Continent and have helped to enhance the prestige of the Technological Laboratory among similar institutions where work on the properties of the cotton hair is being carried out. Altogether 13 such bulletins have been published.

(5) *Technological Research.*—Side by side with this work a number of technological problems, which are of special interest to the cotton industry, were tackled. Among these may be mentioned "The effect of using different spindle speeds on the results of spinning tests," "The effect of using different number of heads of drawing on qualities of the resulting yarn," "The effect of temperature and humidity on cotton spinning," "The limit spinning tests on Indian cottons," etc., etc. The results of these investigations have been published in the form of Technological Bulletins, Series A, of which 17 have been published.

(6) *Moisture Tests.*—The moisture content of a bale of cotton is very important to the dealer from the economic point of view. The question of the normal moisture content in bales of different trade descriptions and its variation with different atmospheric conditions has therefore loomed large on the horizon for some time past. The problem is being investigated in the following two ways :—

- (i) Variation in the weight of a bale.
- (ii) Normal moisture content of a bale.

(i) *Variation in the weight of a bale.*—About two years ago it was suggested that the Laboratory should undertake a thorough investigation on "the variation in the weight of a cotton bale" which is exposed to the specific atmospheric conditions prevailing in Bombay cotton godowns. The experiments were started last June. Bales of *Broach*, *Berars* and *Bengals* cottons, which were kindly supplied by the East India Cotton Association for this purpose, were stored in a godown and in a room in the Cotton Exchange Building, Sewri. These have been subjected to regular weekly weighings, on a sensitive Avery Platform Balance, for a whole year, during which period continuous records of the humidity and the temperature in the godown and the room were kept. The results of this investigation are now complete.

and will soon be published. In the meantime, a second series of similar experiments was started last March and, as before, it is proposed to complete the cycle of 12 months for this series.

(ii) *Normal moisture content of a bale.*—Towards the end of last year a suggestion was made that, in collaboration with the East India Cotton Association, the Laboratory should undertake to determine the moisture content of samples of cotton which would be selected for this purpose by the Appeal Committee of the Association. The object of these tests was to collect sufficient data for establishing a system of "blind survey" as regards the percentage of moisture in cotton bales of different trade descriptions. Two rooms, in the Cotton Exchange, Sewri, were placed at the disposal of the Technological Laboratory for this purpose. These have been equipped with the necessary testing apparatus. Since then the samples of cotton selected by the Appeal Committee are being tested for their moisture content.

It was realized that the proposed system of "blind survey" could only be placed on a rational basis if the true percentage of moisture in bales of cotton pressed under known conditions of temperature and humidity was also known. It was therefore suggested by the writer that the East India Cotton Association should supply a few bales each of *Berias*, *Oomras*, *Punjab-American* and *Mollisoni* cottons. The East India Cotton Association very kindly accepted the suggestion and supplied 40 bales for this purpose. The atmospheric humidity and temperature prevailing in the pressing factories were recorded either by a member of the staff of the Laboratory or by an employee of the British Cotton Growing Association. In these tests five samples are drawn from each bale in such a way as to take in the sides, the middle portion and the different layers of the bale and their moisture content is determined. From a knowledge of the net weight of the bale, the percentage of moisture present in it can be readily calculated. The experimental part of the work is now finished and the results will soon be presented in the form of a report.

(7) *Miscellaneous.*—These are the major problems which have engaged the attention of the staff of the Laboratory. But in addition to these it was found possible to spare time for a number of minor problems whenever the assistance of the Laboratory was required. For instance, soon after the commencement of work in the Laboratory the danger of boll-weevil infection, penetrating into India became acute. The problem was referred to the Laboratory and a method of fumigating the American bales imported into India was perfected which makes their entry quite safe. Under a Notification of the Government of India all bales of American cotton imported into India are now fumigated according to the method.

On two occasions the Laboratory has been approached with a request to supply exhibits prepared from Indian cottons, to be shown in the Textile Exhibitions in England. A very large number of exhibits containing halo-patterns, Baer sorter patterns, card sliver, bobbins, and knots of yarns, etc., etc., were prepared and supplied. These exhibits undoubtedly help to popularise the better varieties of Indian cottons in the outside markets.

Mention may also be made of the examination of ancient relics, reputed to be some 5,000 years old, which were discovered at Mohenjo-Daro. As a result of this work it was definitely established that the use of cotton was known in India as early as 3,000 B.C. though the earliest authenticated date of specific reference to cotton is 800 B.C.

PART II.

It was stated in Part I that the agricultural samples, tested in connection with the various research schemes for introducing improved varieties of cotton, constituted 65 per cent. of the total for the last seven seasons. As the authoritative valuation of new varieties of cotton is one of the primary functions of the Laboratory, it is clear that in any programme of work for the future, this phase of the Laboratory's activities must be given a prominent place. This is all the more necessary as many of the research schemes financed by the Committee are now maturing. The facilities offered by the Laboratory for undertaking spinning tests should, therefore, as in the past, be freely placed at the disposal of the Agricultural Officers engaged in cotton breeding.

As regards the standard cottons the question whether their fibre-properties, as enumerated on page 20, should be determined in the subsequent seasons, with a view to correlate them with the spinning values of these cottons will have to be considered in the light of the conclusions arrived at in the forthcoming Bulletin on the subject by Dr. A. J. Turner. It will then be possible to find out which of these fibre-properties are more closely related to the spinning value and to what extent. It will also be open for consideration whether the time and labour involved in the determination of the less important fibre-properties are compatible with the small additional information yielded by them. The discussion of these questions, however, must be postponed till the Bulletin, referred to above, makes its appearance.

In the meantime the activities of the Laboratory may be extended along the following lines:—

(1) *Practical method for sampling cotton crops.*—The agricultural samples tested at the Laboratory are usually grown on the Government Agricultural Farms. This year samples of *Banilla* cotton, collected from the districts and grown under the ordinary field conditions, were also tested. This was done with the specific purpose of estimating the average quality of the crop of this cotton, which had given fluctuating results in the previous seasons. In my opinion this method of sampling a cotton crop should be applied to other varieties as well. If the samples selected for this purpose are distributed uniformly over the area under cultivation of a given variety, the tests will reveal not only the average quality of the crop but also the localities which are most suited for growing that variety. The selection of cottons to be examined in this fashion may be left to the Technological Research Sub-Committee which, including as it does representatives of trade and industry amongst its members, is in a position to give expert advice.

(2) *Trade Tests.*—The results of tests on trade samples are at present published in about a fortnight's time from the receipt of these samples. While they are of general interest to the trade, I am told, they would be of much greater value to the mills supplying the samples if they could be communicated to them within a much shorter time. As matters stand at present the spinning-test results are ready within 4 to 5 days of receiving the sample. The remaining time is taken up in the printing and publishing of those results. If the Indian Central Cotton Committee would agree to a limited number of tests being made for individual mills, which apply for the same, I am of opinion that a large number of mills would welcome this step and would be willing to benefit by an arrangement, whereby the results of the tests would be communicated to them on the fourth or fifth day of submitting a sample.

(3) *Technological Work.*—I have already referred to the various technological problems which have already been investigated at the Laboratory. Many of them were in the nature of spade-work and were essential in order to place the tests of the Laboratory on a sound basis. This object having been achieved, we are now in a position to go ahead and tackle problems relating to blow-room treatment, carding, preparatory stages, spinning, etc., which should be of special interest to the Indian mill industry. I have indicated a number of such problems below. In selecting these out of the many which presented themselves to my mind, my aim was to leave aside those which are, more or less, of an academic nature, and to concentrate upon those which are characterized by immediate utility and practical importance. As the routine testing of agricultural and trade samples permits, it is proposed to take up the following technological problems for investigation.

(a) *Neps in Cotton.*—The problem of neppiness is perhaps one of the most difficult problems which at present confront the cotton industry. As is well known, there are cottons which possess, to a by no means small degree, the desirable qualities of length, fineness, strength, etc., they are capable of giving yarns which are strong and fairly even but they suffer from neppiness to such an extent as to vitiate their good qualities. Unfortunately it is generally the long and fine cottons which suffer relatively most from neppiness. In fact, in some cotton-growing areas the trouble is so persistent that, in order to avoid neppiness at any cost, the cultivation of the comparatively shorter and coarser types has even been suggested. In spite of the fact that a fair amount of work has been done elsewhere the true causes of neppiness are only vaguely understood. Two rival views have been advanced from time to time. The first is that neps are caused either by faulty ginning or by the machinery (particularly the carding engine) employed for the cleaning of cotton which makes use of the presence of minute impurities to roll the fibres into neps. According to the second hypothesis neppiness is essentially present in the cotton itself in the form of an abnormally large number of immature and thin-walled fibres and the part played by machinery is simply to bring it out and make it visible to the unaided eye. In view of the fact that in the course of a year over 400 samples of cotton grown under widely different climatic conditions are spun and tested at the Technological Laboratory, it is evident that we have here an excellent opportunity for carrying out an exhaustive research on the causes of neppiness and the various factors which influence it. It is proposed to tackle this problem in two ways. On the one hand, some 25 cottons have been very carefully selected and a thorough microscopic examination of the state of maturity of their fibres is being made. These 25 cottons between themselves represent most of the factors which are held responsible for neppiness, such as differences in variety, environment, climate, rainfall and ginning machinery. The microscopic examination is rather a tedious and long process but I have no doubt that ultimately it will throw a great deal of light upon the relative importance of the factors enumerated above. Side by side with it, it is proposed to obtain different varieties of cotton, gin them in carefully set roller gin and saw gin, spin them under identical conditions and compare the neppiness of their yarns. This would make it possible to determine how much of the neppiness is caused by the machinery and how much is inherent in the cotton itself. It is necessary for this purpose that the Technological Laboratory should possess its own gins, of a small capacity, so that, on the one hand, no transposition of samples is possible, and, on the other, proper care can be bestowed on the settings of these machines.

(b) *High Drafting.*—The practice of high drafting has gained such widespread recognition that no mill nowadays can afford to ignore it. The Technological Laboratory has already made a beginning in this matter with tests on mixings of American and Desi cottons which were spun on the two high-draft systems then available and compared with the ordinary system. It is now proposed to extend this investigation, using mixtures of suitable Indian cottons such as *Cambodia* and *Wun* and *Punjab-Americans 4-F* and *289-F*, etc. Since the work referred to above was completed we have acquired another ring frame embodying the 4-roller high-draft system of Messrs. Tweedales and Smalley's and are expecting a fourth one, with the C.S.L. system, manufactured by Messrs. Platt Bros. The results of these comparative tests should be both interesting and useful from the practical point of view.

(c) *Balanced and unbalanced drafts.*—On account of the large number of samples tested annually at the Technological Laboratory one or at the most two rovings are prepared for the three counts into which a cotton is ordinarily spun. In many cases, therefore, the draft is necessarily unbalanced. The validity of using unbalanced drafts with pure cottons was investigated some time ago and it was shown that so far as pure cottons are concerned, there is no appreciable difference between the strength and character of the yarns produced by balanced and unbalanced drafts. But in actual practice pure cottons are rarely used and it is possible that the effect of drafting is more pronounced with mixings than with pure cottons. It is therefore proposed to complete the former investigation by carrying out parallel tests on yarns made from mixings of cottons with balanced and unbalanced drafts. In order to cover as wide a range as possible, it is proposed to prepare the following types of mixings :—

- (a) A long and fine cotton with a short and coarse cotton ;
- (b) A long and comparatively coarse cotton with a short and coarse one ;
- (c) A long and fine cotton with a short and comparatively fine cotton.

It is to be understood that the terms "long," "fine," "short" and "coarse" are used here in the relative sense.

(d) *Combing of better types of cotton.*—As the general character of the Indian cotton crop gradually improves it is clear that the improved varieties will be found suitable for finer counts. Looking ahead it is not difficult to imagine that sooner or later the better types of Indian cottons will be used in mixings for 60's warp or 80's weft. It is proposed to start preliminary work on this problem by combing the best types of Indian cottons available in the market, spinning them to the highest counts they would economically spin and testing the yarns, thus produced, in the usual way for strength, etc. Apart from the information that such an investigation will place in the hands of the trade it is hoped that it will indirectly stimulate the cultivation on a larger scale of the better types of Indian cottons.

(e) *Moisture content of bales and its effect on the spinning value of cotton.*—Last year experiments were undertaken with a view to follow throughout a whole year the changes in the weight of cotton bales of different trade

descriptions kindly supplied for this purpose by the East India Cotton Association. This year at the request of the Association arrangements have been completed at Cotton Exchange, Sewri, for the accurate determination of moisture-content in such samples as are regarded unsatisfactory by the Appeal Committee of the Association. I am told that this work is only a preliminary step to the introduction of a system of "blind surveys" in the Bombay cotton market and also a means for tackling the broader question of the malpractice of watering of cotton. But before the results of these moisture tests can be used, in a given case, for the purpose of valuation, it is absolutely necessary that the normal moisture content of a cotton bale of similar trade description should be known with a fair degree of accuracy. I, therefore, suggested to the Appeal Committee of the Association that they should arrange for the supply of a limited number of bales of different trade descriptions at different times of the season and see that these bales are pressed in reliable factories under known conditions of humidity and temperature. The moisture-content of these bales will then be determined according to the standard method and, provided the investigation is extended over a sufficiently long period and a fairly large number of bales is tested, the results of this investigation should form a satisfactory basis for the system of blind surveys contemplated by the Association. The Board of the East India Cotton Association has very kindly accepted this suggestion and arrangements are already afoot whereby bales supplied by the Association from time to time will be tested for moisture-content and a record maintained. As remarked above these bales will be pressed under known conditions of humidity and temperature, which will be noted by one of our Junior Testers sent to the pressing factories for this purpose, his expenses of journey being defrayed by the Association. Side by side with this it is intended to find out what effect, if any, excessive moisture has upon the spinning value of a cotton. I propose to ask the Board of the East India Cotton Association to kindly supply small samples from such bales as are found excessively damp, by actual moisture-content determination, for the purpose of a spinning test at the Technological Laboratory. It is hoped that by the end of this year useful data correlating the moisture-content of cotton with its spinning performance will be available.

(f) *Twists and settings in the fly-frames.*—When work was originally started in the Technological Laboratory some arbitrary scale of settings and twists in the fly-frames had to be adopted. This scale, which is uniform for all cottons tested has been adhered to in the past. But as we are now called upon to test cottons differing widely in length and fineness of staple, especially among those which are yet in the experimental stage, it is clear that time has come when a systematic investigation should be carried out with a view to find out the optimum settings and twists which are suitable for the different types of cotton, divided broadly into a few classes. It is proposed to take up this investigation in hand as the testing of routine samples permits.

(g) *Carding.*—Some of the most important and, at least theoretically, least understood problems are those relating to the carding of cotton. The function of a card, as we know, is to remove such small impurities as have hitherto clung to the fibres, to straighten them out and to extract the immature, short, broken, or nappy fibres. But even cursory observation is enough to convince one that during the process a certain amount of good fibres are either removed by the card or damaged by it. The subsequent behaviour of the cotton in the spinning room and the properties of the yarn spun from it depend, to a considerable extent, not only upon the care which is bestowed

on the general upkeep of the card but also upon its settings being accurate and correct. But the correctness of settings is, strictly speaking, determined by the length and fineness of the cotton and considering the diverse types of cottons tested annually at the Technological Laboratory it is clear that we have here a set of problems work on which should yield valuable results (so far as Indian cottons are concerned). With our usual pressure of work it would hardly be possible to examine the effect of changing all the settings with different types of cotton but it should be possible to do so in the case of those which play the most important part. Side by side with the examination of the yarn-strength fibre tests will be made with a view to find out the percentage of good and strong fibres in the various card-wastes with different settings.